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Beaver Valley Power Station, Unit No. 2
Docket No. 50-412 License No. NPF-73
LER 2003-002-01

United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

In accordance with Appendix A, Beaver Valley Technical Specifications, the following Licensee Event Report supplement is submitted:

LER 2003-002-01, 10 CFR 50.73(a)(2)(i)(B), "Potential to Deadhead a Component Cooling Water System Pump Violates Safety Analyses Assumptions."

L. W. Pearce
L. William Pearce

Attachment

c: Mr. T. G. Colburn, NRR Senior Project Manager
Mr. P. C. Cataldo, Sr. Resident Inspector
Mr. H. J. Miller, NRC Region I Administrator
INPO Records Center (via electronic image)
Mr. L. E. Ryan (BRP/DEP)

IE22

NRC FORM 366 (7-2001) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 7-31-2004

Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by Internet e-mail to bjs1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
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4. TITLE

Potential to Deadhead a Component Cooling Water System Pump Violates Safety Analyses Assumptions

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									None	
06	11	2003	2003	– 002	– 01	09	29	2003	FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE	1
10. POWER LEVEL	100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)

20.2201(b)	20.2203(a)(3)(ii)	50.73(a)(2)(ii)(B)	50.73(a)(2)(ix)(A)
20.2201(d)	20.2203(a)(4)	50.73(a)(2)(iii)	50.73(a)(2)(x)
20.2203(a)(1)	50.36(c)(1)(i)(A)	50.73(a)(2)(iv)(A)	73.71(a)(4)
20.2203(a)(2)(i)	50.36(c)(1)(ii)(A)	50.73(a)(2)(v)(A)	73.71(a)(5)
20.2203(a)(2)(ii)	50.36(c)(2)	50.73(a)(2)(v)(B)	OTHER Specify in Abstract below or in NRC Form 366A
20.2203(a)(2)(iii)	50.46(a)(3)(ii)	50.73(a)(2)(v)(C)	
20.2203(a)(2)(iv)	50.73(a)(2)(i)(A)	50.73(a)(2)(v)(D)	
20.2203(a)(2)(v)	X 50.73(a)(2)(i)(B)	50.73(a)(2)(vii)	
20.2203(a)(2)(vi)	50.73(a)(2)(i)(C)	50.73(a)(2)(viii)(A)	
20.2203(a)(3)(i)	50.73(a)(2)(ii)(A)	50.73(a)(2)(viii)(B)	

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
L. R. Freeland, Manager Regulatory Affairs / Performance Improvement	(724) 682-5284

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED			15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

16. ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

During an evaluation of a previously identified design review issue with the Component Cooling Water System (CCP) at Beaver Valley Power Station (BVPS) Unit No. 2, it was determined that CCP minimum pump flow may not be met during a post-accident scenario involving specific conditions and timing. Specifically, the "B" CCP pump had been previously replaced with a stronger (head vs. flow) pump than the "A" or "C" train CCP pump. With the prior CCP operating criteria, a design bases accident (DBA) involving a complete loss of offsite power (LOOP) and a consequential start of both trains of CCP after onsite emergency power is restored by both emergency diesel generators starting, could result in the CCP pump with the weaker pump head versus flow characteristics becoming deadheaded and losing its minimum required flow. This could lead to failure of the weaker CCP pump. A single failure is then postulated (as required) to occur on the stronger "B" CCP pump which results in no CCP flow. This was determined to be a condition prohibited by plant Technical Specifications since the CCP system operation is needed for BVPS Unit 2 to reach Mode 5. Further review identified an additional post-accident scenario involving a LOOP and a containment isolation Phase A which needed to be addressed by the engineering analyses developed to resolve this issue. The new scenario involved a pump runout condition.

The root cause of this condition is the original design of the BVPS Unit 2 CCP system in that the system had inherent flow instability characteristics which required constant automatic operation of the system's differential control valves for appropriate compensation. The safety significance of this event was determined to be small. Corrective actions were implemented to eliminate the possibility for losing CCP flow following a DBA.

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PLANT AND SYSTEM IDENTIFICATION

Westinghouse-Pressurized Water Reactor (PWR)
Component Cooling Water System (CC)

CONDITIONS PRIOR TO OCCURRENCE

Unit 2: Mode 1 at 100 % power

There were no systems, structures, or components that were inoperable that contributed to the event other than as described below.

DESCRIPTION OF EVENT

During a follow-up evaluation of a previously identified design review issue with the Component Cooling Water System (CCP) at Beaver Valley Power Station (BVPS) Unit No. 2, it was determined that CCP minimum pump flow may not be met during a scenario involving very specific conditions and timing. Specifically, the "B" CCP pump had been previously replaced with a stronger pump impeller (stronger refers to greater head vs. flow) than the "A" or "C" train CCP pumps. With the prior CCP operating criteria, any event involving a complete loss of offsite power (LOOP) and an automatic consequential start of both trains of CCP after onsite emergency power is restored by both emergency diesel generators starting, could result in the CCP pump with the weaker pump head versus flow characteristics becoming deadheaded and losing its minimum required flow. This condition existed whenever the stronger "B" CCP pump was being credited as being operable to fulfill BVPS Unit No. 2 Technical Specification 3.7.3.1 which requires two primary component cooling water subsystems to be operable in Modes 1-4. Deadheading an operating CCP pump following a LOOP could result in little to no flow through the pump and result in bearing and seal failure in that CCP pump in a short period of time. This failure would be a consequential result of the postulated initiating Design Basis Accident (DBA) event which also leads to a LOOP. If the design-required single failure is then postulated to occur on the second operating CCP train pump, which is postulated to occur after the weaker CCP pump is deadheaded and fails, then this would lead to a complete loss of CCP flow since the single failure would remove the only remaining operable CCP pump. The complete loss of CCP flow would remove the ability of BVPS Unit No. 2 to operate the Residual Heat Removal System and could prevent the plant from being cooled down to Mode 5 following a postulated DBA event. With no CCP flow, the plant would be able to cooldown to Mode 4 using secondary system cooling, but not be able to enter Mode 5. BVPS Unit No. 2 is licensed to be capable of depressurizing and cooling down to Mode 5 following any DBA which does not involve an adverse containment environment.

During previous normal operation, one CCP pump was typically operating with the pressure control valves in manual mode in each CCP train's piping. The pressure control valves ensure adequate minimum flow through the operating CCP pump by recirculating some of its discharge flow back to the suction of the operating CCP pump. The pressure control valves are manually throttled to

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operate within a specified delta-pressure band at a specified flow rate. The original design of the CCP system had these pressure control valves operating automatically based on the sensed differential pressure across the valve. However, these CCP valves have been operated in manual for many years. The previous pressure control band for these valves would have adequately accommodated both single CCP pump operation and two CCP pump operation for CCP pumps with similar operating pump head curves. However, the pressure control band did not provide proper response with one stronger pump. The impact on the post-LOOP situation was not recognized when the "B" CCP pump was replaced with a stronger pump impeller in 1997. The condition described in this report would have been in place whenever the CCP pressure control valves were operated in manual control and the "B" CCP pump was credited as operable following the installation of the stronger pump impeller.

This concern does not apply to BVPS Unit No. 1 because Unit 1 does not have a significantly stronger Component Cooling Water System pump like Unit 2 and because Unit 1 is not licensed and takes no credit in UFSAR safety analyses to be capable of entering Mode 5 following a postulated DBA.

Further engineering review of the BVPS Unit 2 CCP flow modeling analysis determined that the specified differential pressure band would not provide sufficient system protection in all postulated accident conditions. Besides the previously identified LOOP scenario, it was determined that the differential pressure band for the pressure control valves would not be acceptable for an event involving a LOOP and a containment isolation phase A. The differential pressure band was not acceptable in that runout conditions would occur on a CCP pump following an event involving a Loss of Offsite Power and a Containment Isolation Phase A when one of the two operating CCP pumps is assumed to fail. Engineering assessments have been performed to determine the correct limits for the CCP pressure control valves pressure band for the additional identified postulated scenario, given various combinations of running CCP pumps, and the revised CCP differential pressure bands were implemented.

REPORTABILITY

BVPS Unit No. 2 is licensed to be capable of depressurizing and cooling down to Mode 5 following any DBA which does not involve an adverse containment environment. The issue described in this LER identifies that the previous operating requirements for the CCP system would allow the CCP flow to be terminated following a low probability scenario following a postulated DBA, as credited in all design bases and licensing bases events following a postulated single failure. This is a design discrepancy that prevents this system from performing its safety functions for all credible conditions for a period of time longer than allowed by Technical Specification 3.7.3.1. This is a condition prohibited by plant Technical Specifications and is reportable pursuant to 10 CFR 50.73(a)(2)(i)(B).

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CAUSE OF EVENT

The root cause of this condition is the original design of the BVPS Unit 2 CCP system. The three CCP pumps have flat or rising head curves below 3000 gpm, which results in unstable operation if the pumps are operating in parallel with high system resistances. This system's inherent flow stability problem is further complicated by system changes introduced by competing automatic differential pressure control valve motion and heat exchanger temperature control valve motion during plant operation. This necessary precise balance has caused difficulty with plant modifications or alignment changes incorporated since original plant startup. Contributing causes were the operation of the CCP differential pressure control valves in manual and the replacement of the "B" CCP pump with a stronger impeller. This resulted in development of a post-accident hydraulic interaction that was not identified until the recent use of a new system modeling technique. The combined effect of the manual pressure control valve operation and the installation of a stronger CCP pump lead to the conditions being established as described in this report.

SAFETY IMPLICATIONS

The condition described in this report is limited to specific scenarios. The scenario where CCP flow is lost would only be possible to occur if 1) the "B" CCP pump was being credited to meet Technical Specification 3.7.3.1 which states "At least two primary component cooling water pumps shall be operable" [three CCP pumps are typically available], 2) if the differential pressure across the CCP system pressure control valves had been initially set near the higher end of its prior allowed acceptance band when the valves were operating in manual control, 3) if a DBA occurs not involving a containment isolation Phase B signal (CIB) since CCP is automatically isolated post-CIB [a non-bounding safety analysis DBA], 4) if there was a complete loss of offsite power (LOOP), 5) if both emergency diesel generators automatically start and subsequently load/start both CCP pumps, 6) if the control room does not recognize the lack of flow through the weaker CCP pump in a timely manner, and 7) if there is a single failure of the stronger "B" CCP pump after the weaker pump has failed due to its low/no flow condition. A second scenario has also been identified similar to the above scenario except with a containment isolation Phase A in addition to the LOOP which results in a pump runout condition.

A complete loss of CCP would not allow the plant to enter Mode 5. The identified scenarios prevent the CCP system from meeting its safety related function as described in the UFSAR, i.e., BVPS Unit 2 must be able to reach cold shutdown for any DBA which does not result in an adverse environment within containment. However, a complete loss of CCP flow would not prevent the plant from safely entering either Mode 3 or Mode 4.

The scenarios described in this report were evaluated using the current Unit 2 PRA model by analyzing two specific alignment configuration cases. The first case assumes the "B" CCP pump is running, the "A" CCP pump is guaranteed to fail and the "C" CCP pump must be manually aligned to the AE bus. This case covers the situation were the "A" and "B" pumps are restarted after a loss of offsite power and the "A" pump fails due to being deadheaded by the "B" pump. The second case is

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similar except the "C" pump is guaranteed to fail and the "A" pump must be manually aligned to the AE bus. This case corresponds to the situation where the "B" and "C" pump are aligned to restart after a loss of offsite power and the "C" pump fails due to being deadheaded by the "B" pump. The sensitivity studies described above result in a maximum delta CDF of less than 1.0E-7 per reactor year and no increase in LERF above the base case for either sensitivity cases. This delta CDF is well below the significance criteria of 1.0E-6. Both the initial scenario involving a pump deadheading condition and the second scenario involving a pump runout condition are similar in that both lead to the loss of the CCP pumps. Thus, the above results are similar for the pump runout scenario.

Based on the above, the safety significance of this event was small.

CORRECTIVE ACTIONS

1. The control room was initially notified to not operate or credit the operation of the "B" CCP to meet Technical Specification 3.7.3.1.

2. Subsequent to the above action, additional calculations were performed to develop acceptable differential pressure bands across the subject pressure control valves based upon specific CCP pump operating configurations. These revised pressure control bands have been implemented into operating procedures to ensure acceptable CCP operation. The differential pressure bands across the pressure control valves have been revised to address additional credible post-design basis accident operating configurations that have been identified.

3. The applicable design basis documents for the CCP system will be revised to identify the additional required design considerations of the stronger "B" CCP pump.

4. A review of the procedure revision process will be performed to determine if additional controls are needed to ensure sufficient design engineering input is provided when a non-normal system arrangement is being instituted.

5. An Engineering Change Request has been developed to address making the pressure control valves in the CCP system more reliable.

Completion of the above and other corrective actions are being tracked through the corrective action program.

PREVIOUS SIMILAR EVENTS

A review of past BVPS Licensee Event Reports for the last three years found four events involving inadequate or incomplete design considerations at BVPS Unit 1 or Unit 2.

- BVPS Unit 1 LER 02-001, "Silt Levels in Main Intake Structure Exceed Allowable Values."

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- BVPS Unit 1 LER 00-001, "Inadequate Guidance Provided to Operators Regarding Post-DBA Operation of SLCRS."
- BVPS Unit 1 LER 00-002, "Condition Outside Design Basis for One Train of River Water System Inoperable."
- BVPS Unit 2 LER 02-001, "Service Water Conditions for the Recirculation Spray System Lead to Technical Specification Noncompliance."

ATTACHMENT

Beaver Valley Power Station, Unit No. 2
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Commitment List

The following list identifies those actions committed to by FirstEnergy Nuclear Operating Company (FENOC) for Beaver Valley Power Station (BVPS) Unit No. 2 in this document. Any other actions discussed in the submittal represent intended or planned actions by Beaver Valley. These other actions are described only as information and are not regulatory commitments. Please notify Mr. Larry R. Freeland, Manager, Regulatory Affairs/Performance Improvement, at Beaver Valley on (724) 682-5284 of any questions regarding this document or associated regulatory commitments.

Commitment	Due Date
The applicable design basis documents for the CCP system will be revised to identify the additional required design considerations of the stronger "B" CCP pump.	As tracked through the Corrective Action Program.
A review of the procedure revision process will be performed to determine if additional controls are needed to ensure sufficient design engineering input is provided when a non-normal system arrangement is being instituted.	As tracked through the Corrective Action Program.